

57. (New) An optical apparatus according to claim 49 or 50, wherein the first, second and third surfaces of said ocular optical system are each formed from a rotationally asymmetric curved surface that corrects aberration due to decentration.

REMARKS

Reconsideration and allowance of the subject application are respectfully solicited.

Claims 11 through 57 are pending, with Claims 11, 17, 23, and 48 being independent. Claims 48 through 57 have been added.

STATEMENT UNDER 37 CFR 1.607(c)

In accordance with the provisions of 37 CFR 1.607(c), the Examiner is respectfully advised that newly added Claims 48 through 57 have been copied in modified form from Claims 1, 2, and 8 through 14 of U.S. Patent No. 6,195,207 ("Takahashi '207") to Koichi Takahashi.

COMMENTS UNDER 37 CFR 1.607(a)

Further to the Request for Interference filed March 16, 2001 (the "Request for Interference"), pursuant to 37 CFR 1.607, Applicants respectfully request that an interference be declared involving all claims, i.e., Claims 11 through 57, of the present application of Shoichi Yamazaki, et al. ("Yamazaki") and at least:

(a) Claims 1, 3 through 12, 14, 15, and 17 through 24 of U.S. Patent No. 5,875,056 ("Takahashi '056") to Koichi Takahashi ("Takahashi") -- as discussed in the Request for Interference; and

(b) Claims 1 through 5 and 8 through 14 of Takahashi '207 as discussed herein.

By way of clarification, Applicants respectfully note that the references at pp. 31-32 of the Request for Interference to "Ingleton" should have read "Staveley", as is clear from the discussion.

For ease in discussion, unless specified otherwise, all references to Takahashi claims herein should be read as references to Takahashi '207.

A. The counts

Applicants respectfully propose a revised version of Count 1, as compared to the version set forth in the Request for Interference. The revised version includes a new alternative, namely alternative (F) (hereinafter "Count 1(F)"). It will be appreciated that this alternative has been formulated upon the basis of Takahashi Claim 1, but with the limitations "having a refractive index larger than 1" and "a chromatic aberration correcting member" having been omitted. The revised version of Count 1 is set forth as follows:

COUNT 1

(A) An optical apparatus comprising:  
means for forming an image to be observed; and  
an ocular optical system for leading said image to  
an observer's eyeball,

said ocular optical system including, in order from  
said image side, a third surface which forms an entrance  
surface, a first surface which forms both a reflecting  
surface and an exit surface, and a second surface which forms  
a reflecting surface, said first to third surfaces being  
integrally formed with a medium disposed therebetween,

wherein said means for forming an image is an image  
display device for forming an image for observation,

said device being disposed at a position facing  
said third surface,

wherein at least said first surface in said ocular  
optical system is formed from a rotationally asymmetric  
curved surface so as to correct aberrations produced by a  
decentered surface having an optical action;

OR

(B) An optical apparatus comprising:  
a device for displaying an image; and  
an ocular optical system for projecting an image  
formed by said device and for leading the image to an  
observer's eyeball,

said ocular optical system comprising at least first, second and third surfaces, in which a space defined by said surfaces is filled with a medium,

said device being disposed at a position facing said third surface,

said at least first, second and third surfaces including, in order from the observer's eyeball side toward said device, said first surface which serves as both a refracting surface and an internally reflecting surface, said second surface which serves as a reflecting surface of positive power and which faces said first surface and is decentered or tilted with respect to an observer's visual axis, and said third surface which serves as a refracting surface closest to said device,

wherein at least said first surface in said ocular optical system is formed from a rotationally asymmetric curved surface so as to correct aberrations produced by a decentered surface having an optical action;

OR

(C) An optical apparatus comprising:  
a device for displaying an image; and  
an ocular optical system for projecting an image formed by said device and for leading the image to an observer's eyeball,

said ocular optical system comprising at least first, second and third surfaces, in which a space defined by said surfaces is filled with a medium,

said device being disposed at a position facing said third surface,

said at least first, second and third surfaces including, in order from the observer's eyeball side toward said device, said first surface which serves as both a refracting surface and an internally reflecting surface, said second surface which serves as a reflecting surface of positive power and which faces said first surface and is decentered or tilted with respect to an observer's visual axis, and said third surface which serves as a refracting surface closest to said device,

wherein at least said first surface in said ocular optical system is formed from a rotationally asymmetric curved surface so as to correct aberrations produced by a decentered surface having an optical action,

wherein any one of said first, second and third surfaces is a decentered aspherical surface;

OR

(D) An optical apparatus comprising:  
a device for displaying an image; and

an ocular optical system for projecting an image formed by said device and for leading the image to an observer's eyeball,

said ocular optical system comprising at least first, second and third surfaces, in which a space defined by said surfaces is filled with a medium,

said device being disposed at a position facing said third surface,

said at least first, second and third surfaces including, in order from the observer's eyeball side toward said device, said first surface which serves as both a refracting surface and an internally reflecting surface, said second surface which serves as a reflecting surface of positive power and which faces said first surface and is decentered or tilted with respect to an observer's visual axis, and said third surface which serves as a refracting surface closest to said device,

wherein at least said first surface in said ocular optical system is formed from a rotationally asymmetric curved surface so as to correct aberrations produced by a decentered surface having an optical action,

wherein any one of said first, second and third surfaces is a decentered aspherical surface, and

wherein any one of said first, second and third surfaces is an anamorphic surface;

OR

(E) An optical apparatus comprising:  
an image display device; and  
an ocular optical system for projecting an image formed by said image display device and for leading the image to an observer's eyeball,

said ocular optical system including a decentered optical element comprising at least first, second, and third surfaces, in which a space defined by said surfaces is filled with a medium, said surfaces including, from said observer's eyeball side toward said image display device, said first surface serving as both a refracting surface and a totally reflecting surface, said second surface serving as a reflecting surface of positive power which faces said first surface and is decentered or tilted with respect to an observer's visual axis, and said third surface serving as a refracting surface closest to said image display device,

said image display device being disposed at a position facing said third surface,

said ocular optical system further including at least one optical surface having refracting action, said decentered optical element and said at least one optical surface being disposed in an optical path which extends from said image display device to said observer's eyeball,

wherein at least said first surface in said ocular optical system is formed from a rotationally asymmetric

curved surface so as to correct aberrations produced by a decentered surface having an optical action;

OR

(F) An optical apparatus comprising:

an image-forming member that forms an image to be observed, and

an ocular optical system provided to lead said image to an eyeball of an observer,

wherein said ocular optical system includes, in order from an image side thereof, a third surface that forms an entrance surface, a first surface that forms both a reflecting surface and an exit surface, and a second surface that forms a reflecting surface, said first, second and third surfaces being integrally formed to face each other across a medium, and

wherein at least one of said first, second and third surfaces is formed from a rotationally asymmetric curved surface that corrects aberration produced by a decentered surface.



B. Correspondence of claims to counts

Summary

Applicants respectfully submit that Takahashi Claims 1 through 5 and 8 through 14 and Yamazaki Claims 48 through 57 additionally correspond to Count 1, as follows.

(1) Takahashi Claims 1, 3/1, 4/1, 5/3/1, and 14/1

Takahashi Claims 1, 3/1, 4/1, 5/3/1, and 14/1 differ from Count 1(F) in that Takahashi Claims 1, 3/1, 4/1, 5/3/1, and 14/1 further require:

- (a) that the refractive index of the medium is greater than one; and
- (b) a chromatic aberration correcting member located between the image-forming member and the eyeball of the observer to correct chromatic aberration produced by the ocular optical system,

with Claims 3/1, 4/1, and 5/3/1 variously requiring:

- (c) that the chromatic aberration correcting member corrects at least chromatic aberration produced by the first surface of the ocular optical system when the first surface acts as an exit surface (Claims 3/1 and 5/3/1);
- (d) that the chromatic aberration correcting member produces chromatic aberration which is approximately equal in quantity but opposite

in sign to chromatic aberration produced by  
the first surface (Claim 4/1); and

- (e) that the chromatic aberration correcting  
member comprises at least one optical surface  
having refracting action (Claim 5/3/1).

(While Takahashi Claim 14/1 further requires that "each" of  
the first through third surfaces is a rotationally asymmetric  
curved surface, that limitation is met by Count 1(F) which  
states that "at least one" of the surfaces is so formed, as a  
result of which Takahashi Claim 14/1 may be discussed with  
Takahashi Claim 1.)

However, Applicants submit that the refractive  
index limitation (a) does not constitute a patentable  
distinction over the recitation in the count that the first,  
second, and third surfaces are integrally formed to face each  
other across the medium. And as to the chromatic aberration  
limitations (b) through (e), Applicants respectfully submit  
that it was known in the art to make the optical element in  
head mounted display system out of two or more different  
materials to provide an achromatic optical element, as shown  
by U.S. Patent No. 5,539,422 (Heacock, et al.). (See, e.g.,  
col. 12, line 55 through col. 13, line 12; Figs. 19, 20.)  
Accordingly, Applicants respectfully submit that Takahashi  
Claims 1, 3/1, 4/1, 5/3/1, and 14/1 would have been obvious  
over Count 1 in view of Heacock, et al.

(2) Takahashi Claims 8/1, 9/8/1, 10/1, and 11/10/1

Takahashi Claims 8/1, 9/8/1, 10/1, and 11/10/1 differ from Count 1(F) in the aspects discussed above with respect to Takahashi Claim 1, but further require that the chromatic aberration correcting member is placed:

(a) between the first surface of the ocular optical system and the eyeball of the observer (Takahashi Claims 8/1 and 9/8/1); or

(b) the third surface of the ocular optical system and an image display device (Takahashi Claims 10/1 and 11/10/1),

with Takahashi Claims 9/8/1 and 11/10/1 further requiring:

(c) that the chromatic aberration correcting member comprises at least one optical surface having refractive action.

As to limitations (a) and (b), Applicants submit that it was known in the art to position an optical member between a first surface in an eyepiece and the eyeball, or a third surface in an eyepiece and an image display device, as shown by European Patent Document 0 408 344 (Staveley).

(See, e.g., Figs. 7 and 9.) Limitation (c) has been discussed above with respect to Takahashi Claim 5/3/1. In view of the foregoing and for the reasons advanced above with respect to Takahashi Claim 1, Applicants respectfully submit that Takahashi Claims 8/1, 9/8/1, 10/1, and 11/10/1 would have been obvious over Count 1 in view of Heacock, et al. and Staveley.

(3) Takahashi Claim 12/1

Takahashi Claim 12/1 differs from Count 1(F) in the aspects discussed above with respect to Takahashi Claim 1 and further in that Takahashi Claim 12/1 requires that the reflection at the first surface of the ocular optical system is total reflection.

However, Applicants respectfully submit that it was known in the art to effect reflection in a helmet mounted display using total internal reflection, as shown by European Patent Document 0 583 116 (Ingleton). (See, e.g., col. 3, lines 1-3; Fig. 5, surface 21.) Accordingly, Applicants respectfully submit that Takahashi Claim 12/1 would have been obvious over Count 1(F) in view of Heacock, et al. and Ingleton.

(4) Takahashi Claim 13/1

Takahashi Claim 13/1 differs from Count 1(F) in the aspects discussed above with respect to Takahashi Claim 1 and further in that Takahashi Claim 13/1 requires that the second surface of the ocular optical system is a reflecting surface arranged to give a positive power to a light beam by reflection.

However, Applicants respectfully submit that the use of such power was known in the art as shown by Ingleton. (See, e.g., Ingleton, concave surface 12.) Accordingly, Applicants respectfully submit that Takahashi Claim 13/1

would have been obvious over Count 1(F) in view of Heacock, et al. and Ingleton.

(5) Takahashi Claims 2, 3/2, 4/2, 5/3/2, 8/2, 9/8/2, 10/2, 11/10/2, 12/2, 13/2, and 14/2

Takahashi Claims 2, 3/2, 4/2, 5/3/2, 8/2, 9/8/2, 10/2, 11/10/2, 12/2, 13/2, and 14/2 differ from Count 1(F) in the aspects discussed above with respect to Takahashi Claims 1, 3/1, 4/1, 5/3/1, 8/1, 9/8/1, 10/1, 11/10/1, 12/1, 13/1, and 14/1, and further in that the former claims require a fitting member fitted to a head of the observer to retain the image-forming member, the ocular optical system, and the chromatic aberration correcting member in front of the observer.

However, Applicants respectfully submit that fitting members were known in the art, as shown by U.S. Patent No. 5,436,765 (Togino '765) (e.g., Fig. 22(a)). For this reason, and the reasons advanced above with respect to Takahashi Claims 1, 3/1, 4/1, 5/3/1, 8/1, 9/8/1, 10/1, 11/10/1, 12/1, 13/1, and 14/1, Applicants respectfully submit that Takahashi Claims 2, 3/2, 4/2, 5/3/2, 8/2, 9/8/2, 10/2, 11/10/2, 12/2, 13/2, and 14/2 would have been obvious over Count 1 in view of the art discussed above and further in view of Togino '765.

(6) Yamazaki Claim 48

Yamazaki Claim 48 is identical to Count 1(F).

(7) Yamazaki Claims 49 through 57

Yamazaki Claims 49 through 57 are submitted by Applicants to be analogous to Takahashi Claims 1, 2, and 8 through 14, as shown by following Table A, but omit the refractive index requirement, and recite an optical member consisting of a material different in dispersion from a material of the medium whereas the Takahashi claims recite a chromatic aberration correcting member:

TABLE A

| Yamazaki Claim     | respectively corresponding Takahashi Claims |
|--------------------|---|
| 49, 50             | 1, 2  |
| 51/49, 51/50       | 8/1, 8/2                                    |
| 52/51/49, 52/51/50 | 9/8/1, 9/8/2                                |
| 53/49, 53/50       | 10/1, 10/2                                  |
| 54/53/49, 54/53/50 | 11/10/1, 11/10/2                            |
| 55/49, 55/50       | 12/1, 12/2                                  |
| 56/49, 56/50       | 13/1, 13/2                                  |
| 57/49, 57/50       | 14/1, 14/2                                  |

Despite the differences, Applicants respectfully submit that Yamazaki Claims 49 through 57 correspond to Count 1 for reasons analogous to those advanced for the corresponding Takahashi claims.

C. Support for Yamazaki Claims

The following establishes that the terms of Yamazaki Claims 48 through 57 are supported by the present

application. It will be appreciated that in this discussion, references to other Yamazaki claims constitute references to the support indicated in the Request for Interference at pages 40-53.

(1) Yamazaki Claim 48

Yamazaki Claim 48 is an independent claim which Applicants submit is supported as shown by the following Table B:

TABLE B

| Yamazaki Claim 48   | support in present application |
|---|--------------------------------|
| [48(a)] An optical apparatus comprising:  | [48(a)] See 11(a).             |
| [48(b)] an image-forming member that forms an image to be observed, and   | [48(b)] See 11(b).             |
| [48(c)] an ocular optical system provided to lead said image to an eyeball of an observer,  | [48(c)] See 11(c).             |
| [48(d)] wherein said ocular optical system includes, in order from an image side thereof, a third surface that forms an entrance surface, a first surface that forms both a reflecting surface and an exit surface, and a second surface that forms a reflecting surface, said first, second and third surfaces being integrally formed to face each other across a medium, and | [48(d)] See 11(d).             |

|  |                           |
|--|---------------------------|
| [48(e)] wherein at least one of said first, second and third surfaces is formed from a rotationally asymmetric curved surface that corrects aberration produced by a decentered surface. | [48(e)] See 22 and 11(h). |
|--|---------------------------|

(2) Yamazaki Claim 49

Yamazaki Claim 49 depends from Yamazaki Claim 48 and further recites that an optical member is located between the image-forming member and the eyeball of the observer, the optical member consisting of a material differing in dispersion from a material of the medium, which Applicants respectfully submit is supported by, e.g., Numerical Example 7 (Abbe Numbers of 57.4 (for i=2-5) and 64.1 (for i=6-9)) (Fig. 8A).

(3) Yamazaki Claims 51/49, 52/51/49, 53/49, 54/53/49, 55/49, 56/49, and 57/49

Yamazaki Claims 51/49, 52/51/49, 53/49, 54/53/49, 55/49, 56/49, and 57/49 ultimately depend from Yamazaki Claim 49 and further recite one or more of the following features, which Applicants respectfully submit are supported as shown by the following Table C:



TABLE C

| Claim | Feature  | Support in present application |
|-------|--|--------------------------------|
| 51    | The optical member is placed between the first surface and the eyeball.  | See 28                         |
| 52    | The optical member comprises at least one optical surface having refracting action.  |                                |
| 53    | The optical member is placed between the third surface and the image display device.   | See 29                         |
| 54    | The optical member comprises at least one optical surface having refracting action.  |                                |
| 55    | Reflection at the first surface is total reflection.   | See 20                         |
| 56    | The second surface of the ocular optical system is a reflecting surface arranged to give a positive power.                                   | See 11(d)(3)                   |
| 57    | The first through third surfaces are each formed from a rotationally asymmetric curved surface that corrects aberration due to decentration. | See 22 and 11(h)               |

(4) Yamazaki Claims 50, 51/50, 52/51/50, 53/50, 54/53/50, 55/50, 56/50, and 57/50

Yamazaki Claims 50, 51/50, 52/51/50, 53/50, 54/53/50, 55/50, 56/50, and 57/50 have been formulated upon the basis of Yamazaki Claims 49, 51/49, 52/51/49, 53/49, 54/53/49, 55/49, 56/49, and 57/49, but further recite a fitting member fitted to a head of the observer to retain the image forming member, the ocular optical system, and the optical member being in front of the observer, which Applicants respectfully submit is supported for the reasons

advanced with respect to Claim 11(g) in the Request for Interference.

D. Summary of proposed interference

The following Tables D through F, the latter of which pertains to Takahashi '207, summarize Applicants' revised proposal for the interference:

TABLE D

|                               |   |
|-------------------------------|---|
| Applicants<br>(Senior Party): | Shoichi Yamazaki and Takeshi Nishimura  |
| Application No.:              | U.S. Patent Application No. 09/511,243<br>filed February 23, 2000   |
| For:                          | HEAD-UP DISPLAY DEVICE WITH CURVED<br>OPTICAL SURFACE HAVING TOTAL REFLECTION<br>(AS AMENDED)   |
| Assignee:                     | Canon Kabushiki Kaisha  |
| Accorded Benefit:             | <u>for Count 1</u><br>(1) U.S. Patent Application No.<br>08/959,285 filed October 24, 1997;<br>(2) U.S. Patent Application No.<br>08/478,688 filed June 7, 1995;<br>(3) Japanese Patent Application No.<br>6-204268 filed August 5, 1994; and<br>(4) Japanese Patent Application No.<br>6-130301 filed June 13, 1994.<br><br><u>for Count 2</u><br>(1) U.S. Patent Application No.<br>08/959,285 filed October 24, 1997;<br>(2) U.S. Patent Application No.<br>08/478,688 filed June 7, 1995; and<br>(3) Japanese Patent Application No.<br>6-130301 filed June 13, 1994. |

|                                  |  |
|----------------------------------|--|
| Claims corresponding to Count 1: | 11-13, 15, 17-20, 21/(17-20), 22/21/(17-20), 23-30, 31/(23-30), 32/(17-20), 32/(23-30), 33/(17-20), 33/(23-30), 34/17, 34/20, 34/(23 and 28-30), 35/18, 35/19, 35/(24-27), 36/(17-20), 36/(23-30), 37/(11-13 and 15), 38/(17-20), 39/21/(17-20), 40/22/21/(17-20), 41/(23-30), 42/31/(23-30), 43/32/(17-20), 43/32/(23-30), 44/33/(17-20), 44/33/(23-30), 45/34/17, 45/34/20, 45/34/(23 and 28-30), 46/35/18, 46/35/19, 46/35/(24-27), 47/36/(17-20), and 47/36/(23-30), and 48 through 57 |
| Claims corresponding to Count 2: | 14, 16, 37/14, and 37/16   |

TABLE E

|                                  |  |
|----------------------------------|--|
| Patentee (Junior Party)          | Koichi Takahashi   |
| Application No.:                 | U.S. Patent Application No. 08/912,119 filed August 15, 1997, Patent No. 5,875,056 granted February 23, 1999   |
| For:                             | HEAD OR FACE MOUNTED IMAGE DISPLAY APPARATUS   |
| Assignee:                        | Olympus Optical Co., Ltd.  |
| Claims corresponding to Count 1: | 1, 3, 5-7, 8/(5-7), 9/8/(5-7), 10-12, 14, 15, 17/(10-12, 14, and 15), 18/(5-7), 18/(10-12, 14, and 15), 19/(5-7), 19/(10-12, 14, and 15), 20/(5-7), 20/(10-12, 14, and 15), 21/(5-7), 21/(10-12, 14, and 15), 22/1, 22/5, 22/10, 23/1, 23/5, 23/10, 24/23/1, 24/23/5, and 24/23/10 |
| Claims corresponding to Count 2: | Claim 4  |

TABLE F

|  |   |
|--|---|
| Patentee<br>(Junior Party)             | Koichi Takahashi  |
| Application No.:                       | U.S. Patent Application No. 09/558,627<br>filed April 26, 2000, Patent No.<br>6,195,207 granted February 27, 2001 |
| For:                                   | HEAD OR FACE MOUNTED IMAGE DISPLAY<br>APPARATUS   |
| Assignee:                              | Olympus Optical Co., Ltd.   |
| Claims<br>corresponding to<br>Count 1: | 1-5 and 8-14  |
| Claims<br>corresponding to<br>Count 2: | none  |

CONCLUSION

Favorable consideration and an early declaration of  
interference are earnestly solicited.

Applicants' undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should continue to be directed to our below-listed address.

Respectfully submitted,



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